

Amendment to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

Claim 1 (previously presented): A method of providing automatic gain and tilt control in a WDM (wavelength division multiplexing) optical communication system, the method comprising:

receiving over an optical fiber at least one sub-band of WDM signals and first and second reference signals, the first reference signal at a first boundary of the sub-band and the second reference signal at a second boundary of the sub-band;

detecting the first and second reference signals;

analyzing the reference signals to determine power variation of the reference signals;

outputting a control signal to compensate for losses and gain tilt accumulation in the sub-band associated with the optical fiber based upon the analyzing step; and

controlling an optical gain unit in response to the control signal.

Claim 2 (original): The method according to claim 1, wherein the optical gain unit in the controlling step is a Raman pump unit, the method further comprising:

injecting a counter-propagant pump light by the Raman pump unit into the optical fiber in response to the control signal.

Claim 3 (original): The method according to claim 2, further comprising:

injecting a co-propagant pump light into the optical fiber by another Raman pump unit.

Claim 4 (previously presented): The method according to claim 2, wherein the counter-propagant pump light in the injecting step is produced by the optical gain unit having a

plurality of laser diodes generating a plurality of output lights of different wavelengths, the output lights being multiplexed.

Claim 5 (canceled)

Claim 6 (canceled)

Claim 7 (canceled)

Claim 8 (previously presented): The method according to claim 1, wherein the analyzing step comprises:

determining a relative power difference between the reference signals.

Claim 9 (previously presented): The method according to claim 1, wherein the analyzing step comprises:

determining an average power of the reference signals.

Claim 10 (previously presented): The method according to claim 1, wherein the analyzing step comprises:

generating voltages corresponding to the reference signals;
comparing the generated voltages to a reference voltage; and
determining whether the reference signals are degraded based upon the comparing step.

Claim 11 (original): The method according to claim 10, further comprising:
outputting an alarm signal based upon determining that one of the reference signals is degraded.

Claim 12 (previously presented): The method according to claim 1, further comprising:

extracting and regenerating the reference signals.

Claim 13 (canceled)

Claim 14 (previously presented): The method according to claim 1, wherein the receiving step comprises receiving over the optical fiber first and second sub-bands of WDM signals, and first and second reference signals for each sub-band, the first reference signal at a first boundary of its sub-band and the second reference signal at a second boundary of its sub-band.

Claim 15 (previously presented): A WDM (wavelength division multiplexing) optical communication system for providing automatic gain and tilt control, comprising:

an optical fiber that carries at least one sub-band of WDM optical signals, a first reference signal at a first boundary of the sub-band, and a second reference signal at a second boundary of the sub-band;

an optical gain unit coupled to the optical fiber and configured to output lights to compensate for losses and gain tilt accumulation in the sub-band; and

a controller configured to control the optical gain unit, the controller detecting and analyzing the reference signals to determine power variation of the reference signals, wherein the controller outputs a control signal to the optical gain unit based upon the analyzed reference signals.

Claim 16 (previously presented): The system according to claim 15, wherein the optical gain unit comprises a Raman pump unit that is configured to inject a counter-propagant pump light into the optical fiber.

Claim 17 (previously presented): The system according to claim 16, further comprising:

another Raman pump unit coupled to the optical fiber and configured to inject a co-propagant pump light into the optical fiber.

Claim 18 (original): The system according to claim 16, wherein the Raman pump unit is located remotely from the controller.

Claim 19 (original): The system according to claim 16, wherein the controller is collocated with the Raman pump unit.

Claim 20 (previously presented): The system according to claim 16, wherein the Raman pump unit comprises:

a plurality of laser diodes that are individually controlled to output a plurality of output signals of different wavelengths, the output signals being multiplexed.

Claim 21 (previously presented): The system according to claim 15, wherein the reference signals are part of the sub-band.

Claim 22 (canceled)

Claim 23 (canceled)

Claim 24 (previously presented): The system according to claim 15, wherein the controller is configured to compute a relative power difference between the reference signals.

Claim 25 (previously presented): The system according to claim 15, wherein the controller is configured to determine an average power of the reference signals.

Claim 26 (previously presented): The system according to claim 15, wherein the controller is configured to generate voltages corresponding to the reference signals and to compare the generated voltages to a reference voltage to determine whether the reference signals are degraded.

Claim 27 (previously presented): The system according to claim 15, wherein the controller is configured to output an alarm signal based upon determining that one of the reference signals is degraded.

Claim 28 (previously presented): The system according to claim 15, further comprising:

an optical service channel (OSC) unit configured to extract and regenerate the reference signals, wherein the controller resides within the OSC unit.

Claim 29 (previously presented): The system according to claim 15, further comprising:

an extraction and regeneration circuit configured to extract and regenerate the reference signals, wherein the controller computes relative power difference and average power of the reference signals.

Claim 30 (previously presented): The system according to claim 63, wherein the optical amplifier is an Erbium Doped Fiber Amplifier (EDFA).

Claim 31 (canceled)

Claim 32 (previously presented): The system according to claim 15, wherein the optical fiber carries first and second sub-bands of WDM optical signals, a first reference signal at a first boundary of each sub-band and a second reference signal at a second boundary of each sub-band.

Claim 33 (previously presented): An optical device for providing automatic gain and tilt control in a WDM (wavelength division multiplexing) optical communication system, comprising:

an input coupled to an optical fiber carrying at least one sub-band of WDM optical signals and reference signals at the boundaries of the sub-band, the input receiving the reference signals;

a plurality of photodiodes configured to convert the reference signals to corresponding electrical signals; and

a controller coupled to the photodiodes and configured to output a control signal to at least one Raman pump unit and a variable optical attenuator to compensate for gain tilt and gain variation based upon the reference signals.

Claim 34 (original): The device according to claim 33, wherein the Raman pump unit is configured to inject a counter-propagant pump light into the optical fiber.

Claim 35 (previously presented): The device according to claim 33, wherein the reference signals are part of the sub-band.

Claim 36 (previously presented): The device according to claim 33, wherein the controller is configured to determine a relative power difference between the reference signals.

Claim 37 (previously presented): The device according to claim 33, wherein the controller is configured to determine an average voltage of the reference signals and to compare the determined average voltage to a reference voltage.

Claim 38 (previously presented): The device according to claim 33, wherein the controller is configured to generate voltages of the electrical signals corresponding to the reference signals and to compare the generated voltages to a reference voltage to determine whether the reference signals are degraded.

Claim 39 (original): The device according to claim 38, wherein the controller is configured to output an alarm signal based upon determining that one of the reference signals is degraded.

Claim 40 (original): The device according to claim 33, further comprising:
an extraction and regeneration circuit configured to extract and regenerate the
reference signals.

Claim 41 (canceled)

Claim 42 (previously presented): The device according to claim 33, wherein the
optical fiber carries first and second sub-bands of WDM optical signals, and reference signals at
the boundaries of each sub-band.

Claim 43 (previously presented): A WDM (wavelength division multiplexing)
optical communication system for providing automatic gain and tilt control, comprising:

an optical fiber that carries at least one sub-band of WDM optical signals and
reference signals at the boundaries of the sub-band;

a light emitting means coupled to the optical fiber for outputting lights to
compensate for losses and gain tilt accumulation;

a controlling means for controlling the light emitting means, the controlling means
detecting and analyzing the reference signals to determine power variation of the reference
signals, the controlling means outputting a control signal to the optical gain unit based upon the
analyzed reference signals.

Claim 44 (original): The system according to claim 43, wherein the light emitting
means includes a Raman pump unit that injects a counter-propagant pump light into the optical
fiber.

Claim 45 (original): The system according to claim 43, further comprising:
another light emitting means that includes a Raman pump unit that injects a co-
propagant pump light into the optical fiber.

Claim 46 (original): The system according to claim 44, wherein the Raman pump unit is located remotely from the controlling means.

Claim 47 (original): The system according to claim 44, wherein the controlling means is collocated with the Raman pump unit.

Claim 48 (previously presented): The system according to claim 44, wherein the Raman pump unit comprises:

a plurality of laser diodes that are individually controlled to output a plurality of output signals at different wavelengths, the output signals being multiplexed.

Claim 49 (previously presented): The system according to claim 43, wherein the reference signals are part of the sub-band.

Claim 50 (canceled)

Claim 51 (canceled)

Claim 52 (previously presented): The system according to claim 43, wherein the controlling means determines a relative power difference between the reference signals.

Claim 53 (previously presented): The system according to claim 43, wherein the controlling means determines an average voltage of the reference signals and compares the computed average voltage to a reference voltage.

Claim 54 (previously presented): The system according to claim 43, wherein the controlling means generates voltages corresponding to the reference signals and compares the generated voltages to a reference voltage to determine whether the reference signals are degraded.

Claim 55 (previously presented): The system according to claim 43, wherein the controlling means outputs an alarm signal based upon determining that one of the reference signals is degraded.

Claim 56 (previously presented): The system according to claim 43, further comprising:

an optical service channel (OSC) unit configured to extract and regenerate the reference signals, wherein the controlling means resides within the OSC unit.

Claim 57 (previously presented): The system according to claim 43, the system further comprising:

extraction and regeneration means for extracting and regenerating the reference signals, wherein the controlling means computes relative power difference and average power of the reference signals.

Claim 58 (previously presented): The system according to claim 67, wherein the amplifying means is an Erbium Doped Fiber Amplifier (EDFA).

Claim 59 (canceled)

Claim 60 (previously presented): The system according to claim 43, wherein the optical fiber carries first and second sub-bands of WDM optical signals, and reference signals at the boundaries of each sub-band.

Claim 61 (previously presented): The method of claim 1, wherein the reference signals are part of the sub-band.

Claim 62 (previously presented): The method of claim 14, wherein the first sub-band is part of C-band, and the second sub-band is part of L-band.

Claim 63 (previously presented): The system of claim 15 further comprising an optical amplifier coupled to the optical fiber and configured to amplify the WDM optical signals, the optical gain unit providing a constant power per channel at an input of the optical amplifier.

Claim 64 (previously presented): The system of claim 32, wherein the first sub-band is part of C-band, and the second sub-band is part of L-band.

Claim 65 (previously presented): The device of claim 34, further comprising a variable optical attenuator configured to control power from the optical fiber injected by the counter-propagant pump light from the Raman pump unit into an Erbium doped fiber amplifier.

Claim 66 (previously presented): The device of claim 42, wherein a first sub-band is part of C-band, and a second sub-band is part of L-band.

Claim 67 (previously presented): The system of claim 43, further comprising an amplifying means coupled to the optical fiber for amplifying the optical signals,

wherein the light emitting means provides a constant power per channel at an input of the amplifying means.

Claim 68 (previously presented): The system of claim 60, wherein a first sub-band is part of C-band, and a second sub-band is part of L-band.